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STUDIES ON THE ARTHROPODS AND MICROORGANISMS OF SOME LIBYAN SOILS

Soil Arthropods and Soil Microorganisms of a Hill at El-Marj Region

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INTRODUCTION

The literature on the distribution of soil arthropods and soil microorganisms at different altitudes is rather scanty.

In the present investigation, a study of the soil arthropods and microorganisms at different altitudes was carried out. Soil samples were collected from a hill approximately 480 meters above the sea level at El-Marj region.

The average degree of temperature in El-Marj region, as stated by Hajjaji (1967) representing an average of 23 years, fluctuates between 50.9 F° in January and74.8f°in August with an annual average of 63.9 F°. Precipitation also varies from 0.01 inch in July to 4.67 inches in Dec., with a total annual precipitation of 19.08 inches.

MATERIALS AND METHODS

The hill from which the soil samples of the present investigation were taken is located in Shtata Valley. The latter is about 20 km to the east of El-Marj town and about 2 km off the road to El-Beida town (Fig. 1). Samples were collected from the eastern side of the hill. Topographical maps of the area indicate that the base of the hill is about 40 m above the sea level. The highest point of the hill was estimated to be about 80 meters high. The hill is made up mostly of limestone, both calcareous and foraminiferous. The top of the hill is almost bare with no vegetation. Therefore, only five stations for the present investigation, located at the base of the hill and at 15, 30, 45 and 60 m high were chosen. The heights of the different stations were estimated using a sighting-level instrument.

The methods, used for counting microorganisms, extracting arthropds and determining the physical properties of the collected soil samples were as in a previous publication (Kolkaila et al 1971). In extracting the soil arthropods, the light was left on for at least 72 hours.

Wild flora from the different locations were collected and identified (Table 1).

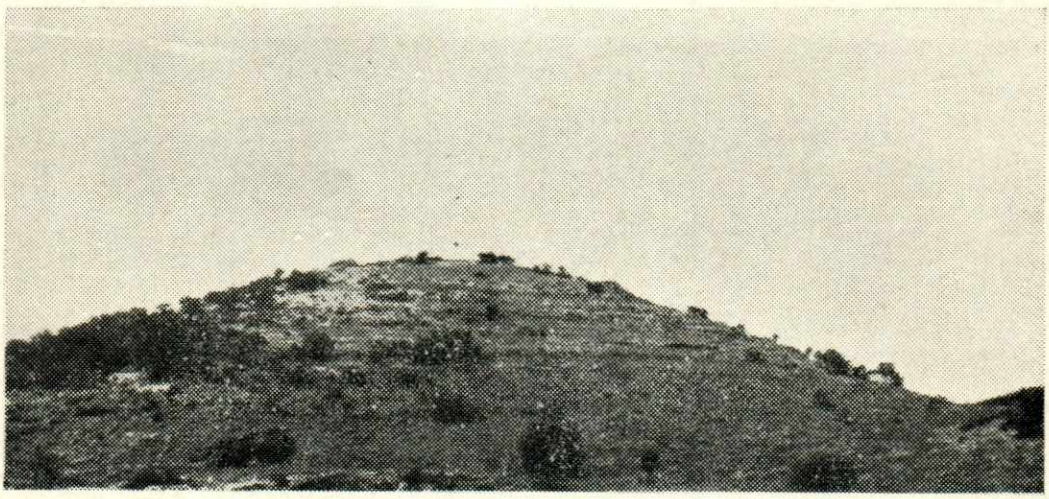

Fig. 1

TABLE I

The Wild Flora at the Different Stations of the Hill

Base of the Hill	Station No. 1 15 m high	Station No. 2 30 m. high	Station No. 3 45 m. high	Station No. 4 60 m. high
1 Hordeum sp.	1. Anagallis arvensis	1. A. arvensis	1. A. arvensis	1. Bromus rigidus
2. Trifolium sp.	2. Avena sp.	2. Bromus sp	2. Hordeum inurinum	2. Trifolium campestre
3. Compositae	3. Koeleria sp	3. Erodium sp.	3. Echium servecum	3. Trifolium angastifolium
	4. Anthenus sp.	4. Phlomis floccosa	4. Borago officinalis	4. Calendula microcanther
	5. Compositae		5. Sangiusorba verrucosa	5. Mercurialis annua
			6. Scabiosa sp.	6. Avena sp
				7. Two Compositae
				8. Two Cumbeliferae
				9. Labiatae.

RESULTS AND DISCUSSION

The soils of the Shtata valley are of the terra-rossa type which were described by Hajjaji (1967). The soil samples taken from the base of the hill were of the same colour and nature as those of the valley but the soils at different heights varied in colour and texture. The soil at the base of the hill was dark red, while at the top of the hill the soil was brownish grey.

TABLE 2

The physical properties of the soil samples

Physical property	Base	15m	30m	45m	60m
Moisture %	8.2	9.0	7.6	8.8	10.6
Water-holding Capacity vol. %	36	36	36	36	10.6
Vol. per 100g (cc.)	86	90	92	86	88
Bulk density	1.162	1.111	1.086	1.160	1.136
Particle density	2.43	2.38	2.38	2.32	2.38
Porosity %	3.1	5.2	5.3	5.0	5.3
Organic matter %	52.2	53.4	54.4	50.0	52.3
pH	7.0	6.5	6.5	6.5	6.0

The important physical properties of the tested soil samples taken at different altitudes of the investigated hill are shown in Table 2. The organic matter content of the tested samples ranged from 3.1 to 5.3% which was much lower than what was reported by Hajjaji (1967). These figures, however, represent the highest record of organic matter content in the different Libyan soils (Kolkaila et al 1971; Makawi et al. 1971 and Makawi and Abd-El-Ghaffar, 1971). As a matter of fact, Abd-El-Malek (1968) stated that subtropical soils are characterized by their low organic matter.

Table 2 indicates that the soils of the different stations of the hill were rather compact and logged, their volumes/100 g were relatively higher than other tested Libyan soils (Makawi and Abd-El-Ghaffar. 1971). Even when comparing their bulk densities with those of the cultivated land of the same valley (Makawi et al. 1971). the bulk density of the hill soil is still lower. This agrees with Buckman and Brady (1960) who concluded that the cultivation of certain crops was responsible for the increase of the bulk density in cultivated soils more than uncultivated ones of the same locality.

Soils at the base of the hill were slightly acidic, while they tended to be neutral as elevations increased (Table 2). Soil samples at the base of the hill had almost the same pH as those of the vally (Makawi et al. 1971).

TABLE 3

... Counts of microoganisms (thousands / lg dry soil). ...

Count	Base	15m	30m	45m	60m
Total count of bacteria	6.300	16.400	10.800	16.400	44.000
Fungi counts	220	146	220	30	200
Counts of Actinomycetes	2.136	2.806	1.330	1.479	2.916
Count of Cellulose-decomposers	5	1	1	1	5

The microbial population of the tested soils are presented in (Table 3 and Fig.2) . Total colony counts of bacteria increased with the increase in altitude. Total counts of bacteria were rather very low at the base of the hill as compared with those of the upper parts of the hill.

Soil samples from the barley cultivated valley below the base of the hill contained, however, high numbers of bacteria (Makawi et al. 1971). This might be due to the different agricultural practices performed in the valley.

Counts of fungi, on the other hand, did not show any correlation with elevation as the case with bacteria (Table 3).

Number of fungi did not change markedly with the increase in altitude except at 45 meters high where they were much less in numbers.

Actinomycetes gave higher counte than any of the previously tested soils in this series of investigations reaching about 2.9 millions per/g of soil at the top of the hill, while cellulose decomposers were higher at the top and at the base of the hill only.

Analysis of the soil samples indicated that the arhropod fauna (Table 4 and Fig. 3) obtained in the present work has revealed the occurrence of several Arthropod classes, other than insects. Pseudoscorpionida, Pauropoda, Chilopoda, Diplopoda and Symphyla, which, to the author's Knowledge, are recorded here for the first time in Libya. Species of Chilopoda and Diplopoda, other than those mentioned here, were recorded by Zavattari (1934) only in Tripolitania (1170 Km west of El-Marj). In the Class Insecta, members of Protura were recorded also for the first time which supports the findings of Makawi et al.(1971). Moreover, Thysanura samples found in the present work were also different from those recorded by previous workers (Zavattary, 1934). The scientific indentification of these mentioned fauna will be published elsewhere.

Table 4 shows a rather regular increase in the total arthropod counts with the increase in altitude. Soil arthropods extracted from station at 45 meters, however, contained the highest population due to its infestation with large numbers of Trombidiform mites (Eriophyidae).

Oribatid mites were generally the most abundant. This agrees with our findings in previous investigations (Kolkaila et al; 1971) and also with the findings of Loots and Ryke (1967), due to the relatively high organic matter content of the tested soils of the hill.

Collembola also increased with the increase in altitude and to a great extent with the increase in the moisture contents of the soil.

TABLE 4 : The Numbers of Soil Fauna

Fauna	Base of the Hill		15 m. High		30 m. Hign		45 m. High		60 m. High		Mean	
	No. in 1L. soil	%	No. in 1L. soil	%	No. in 1L. soil	%	No. in 1L. soil	%	No. in 1L. soil	%	No. in 1L. soil	%
Nematoda	1	—	2	—	—	—	1	—	—	—	0.8	--
Pseudoscropionida	—	--	1	—	—	—	—	—	—	—	0.2	--
Pauropoda	—	—	1	0.265	1	0.46	—	—	3	0.795	1.0	0.304
Chilopoda	1	1.09	—	--	—	—	—	—	—	—	0.2	0.062
Diplopoda	—	—	—	--	—	—	—	—	3	0.795	0.6	0.159
Symphyla	1	1.09	—	--	—	—	—	—	—	—	0.2	0.062
Mites :												
Mesostigmata	20	21.80	115	30.475	70	32.2	70	11.48	194	51.41	93.8	25.549
Trombidiformes	5	5.45	17	4.505	50	23.0	414	67.896	12	3.18	99.6	19.825
Oribatei	50	54.5	230	59.80	83	38.18	100	16.4	92	24.38	111.6	24.872
Total	75	81.75	362	94.12	203	93..38	584	95.776	298	78.97	304.4	70.246
Protura	—	—	—	—	—	—	6	0.984	9	2.385	3	0.674
Collembola												
Arthropleona	5	5.45	9	2.385	9	4.14	18	2.952	22	5.83	12.6	3.17
Others	—	--	2	0.53	1	0.46	1	0.164	9	2.285	2.6	0.708
Total	5	5.45	11	2.915	10	4.6	19	3.116	31	8.215	15.2	3.878
Thysanura	1	1.09	—	—	—	—	1	0.164	2	0.53	0.8	0.16
Psocoptera	2	2.18	—	—	—	—	2	0.328	—	—	0.8	0.109
Thysanoptera	3	3.27	—	—	—	—	—	—	2	0.53	1.0	0.171
Homoptera												
Aphididae	—	--	—	—	1	0.46	—	—	—	—	0.2	0.90
Pseudococcidae	—	—	1	0.262	2	0.92	—	—	—	—	0.6	0.237
Total	—	—	1	0.262	3	1.38	—	—	—	—	0.8	0.327
Coleoptera (Larvae)												
Staphylinidae	1	1.09	2	0.53	—	—	—	—	25	6.625	5.6	1.475
Others	1	1.09	—	—	—	—	—	—	—	—	0.2	0.022
Total	2	2.18	2	0.53	—	—	—	—	25	6.625	5.8	1.497
Diptera (Larvae)	—	—	—	—	—	—	—	—	2	0.53	0.4	0.106
(Adults)	—	--	—	—	—	—	2	0.328	2	0.53	0.8	0.171
Total	—	--	—	—	—	—	2	0.328	4	1.26	1.2	0.277
Hymenoptera	1	1.09	—	—	—	—	—	—	—	—	0.2	0.062
Total Arthropoda	91	100	377	100	217	100	608	100	377	100	333	100
Total Fauna	92	—	380	—	217	--	614	—	377	—	335	—

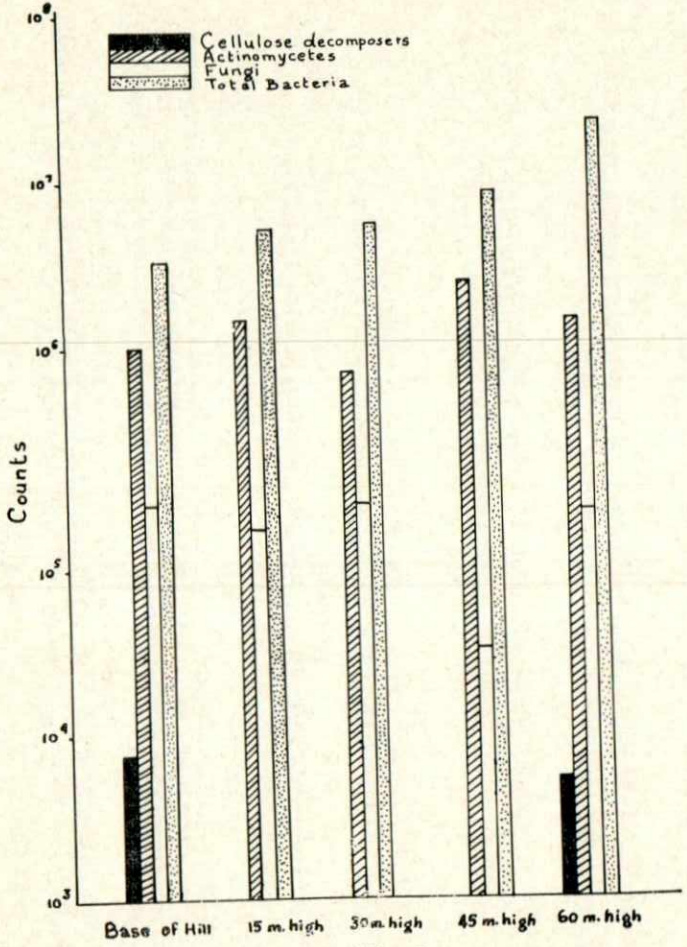
Cellulose decomposers
Actinomycetes
Fungi
Total Bacteria
Counts
Base of Hill
15 m. high
30 m. high
45 m. high
60 m. high

Fig. 2

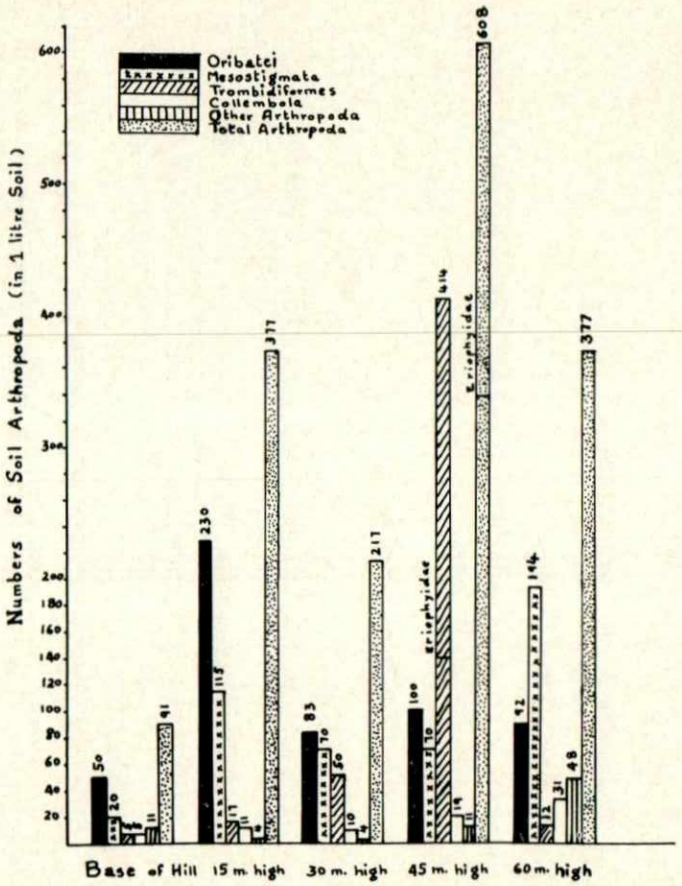
Oribatei
Mesostigmata
Trombidiformes
Collembola
Other Arthropoda
Total Arthropoda
Numbers of Soil Arthropoda (in 1 litre Soil)
Base of Hill
15 m. high
30 m. high
45 m. high
60 m. high

Fig. 3

SUMMARY

The distribution of soil Arthropods and soil Microorganisms at different heights of a hill at El-Marj region was carried out. The base of the hill is 400meters above the sea level and samples were taken 15 meters apart.

Members of several classes of Arthropoda as well as members of orders Protura and Thysanura were recorded here for the first time. Oribatid mites were dominating due to the high organic matter content. Number of Collembola were higher than in other tested samples of Lybian soils and increased with the moisture contents.

There appeared a general trend of increase in the populations of both soil Arthropods and soil Microorganisms as height increased.

Counts of Actinomycetes were higher than in other samples analysed previously.

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